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Articles:

Click On The Topic You Wish To View

- **Preliminary investigation of ultrasonic root end preparation**
- **Cytotoxicity evaluation of six root canal sealers**
- **A comparative study of the sealing ability of two root canal obturation techniques**
- **The endodontic file as a disposable instrument**
- **A study of the apical microleakage of a gallium alloy as a retrograde filling material**
- **Evaluation of a solvent-softened gutta-percha obturation technique in curved canals**
- **Comparison of the sealing ability of laser-softened, laterally condensed and low-temperature thermoplasticized gutta-percha**
- **Dentinal heat transmission induced by a laser-softened gutta-percha obturation technique**
- **Infiltrate of chronic lymphocytic leukemia appearing as a periapical radiolucent lesion**
- **Irreversible pulpal damage of teeth adjacent to recently placed osseointegrated implants**

Preliminary investigation of ultrasonic root end preparation

Engel TK, Steiman. Preliminary investigation of ultrasonic root end preparation. J Endodon 1995;21:443-5.

PURPOSE: To compare the preparation time, degree of canal debridement, and removal of tooth structure resulting from ultrasonic (US) root-end preparation with that of the traditional, microhandpiece (MH) technique.

M&M: 30 roots containing two canals (from mandibular molars and single-rooted maxillary premolars) were accessed, prepared (master apical file size #30), and obturated (firm-set Ultrafil/Roth's 801). The obturated teeth were mounted, apically resected (perpendicular to the long axis of the root), and assigned to 3 groups of 10 each. Group 1 - prepared using a slow-speed MH (#1 carbide bur) and rinsed; group 2 - prepared as in group 1, followed with 10 s of re-instrumentation with a Neosonic US instrument (power setting-10); and group 3 - prepared using only the US. Preparation times were recorded, the remaining debris was scored in a blind fashion, and changes in the canal area after preparation were determined.

RESULTS: One postoperative fracture occurred in each group. No significant differences were found in the time of preparation between groups 1 and 3; however, preparation using the combined technique (group 2) did take significantly longer than the other techniques. Although preoperative canal areas were similar between groups, postoperative areas were significantly greater with the combined technique than for either other method. Ultrasonic preparations (group 3) were significantly less in resulting mean area than the others. Due to the subjective nature of the debris score interpretations, statistical creativity was necessary to conclude differences with this variable. Significant improvements in debris removal were found whenever MH preparation was done, but not when US was used alone.

C&C: The authors discussed several advantages and disadvantages for each technique, and conclude with an overall endorsement of the ultrasonic instrument as an adjunct to surgical endodontics. Advantages of US include improved instrument control, more centered preparations, and less tendency to gouge canal walls in thin areas; considering the overall decrease in preparation size, these factors reduce risk of perforation in deeply fluted roots. Disadvantages of US include the expense of the system, and less complete debridement (shown in this study). Ultrasonic root-end preparations seem to be particularly indicated whenever a high risk of perforation exists or when limited access to the root apex is a consideration.

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Christopher F. Bates

Cytotoxicity evaluation of six root canal sealers

Gerosa R, Menegazzi G, Borin M, Cavalleri G. Cytotoxicity evaluation of six root canal sealers. J Endodon 1995;21:446-8.

PURPOSE: To evaluate the toxicity of 6 different endodontic sealers.

M&M: The following sealers were tested: Pulp Canal Sealer (PCS), AH-26, Rocanal-R2 and Rocanal-R3, Bioseal, and Endomethasone. All cements were mixed according to manufacturers' directions. 30 teflon tubes for each cement were filled, sterilized, and placed in phosphate-buffered saline (PBS) for 1 week, placed in fresh PBS for 1 more week and then transferred to cluster well cell culture plates with human gingival fibroblasts and incubated at 37° C, 100% humidity for 24, 48, and 72 h. Fibroblasts were obtained from biopsies of normal attached gingival tissue from the lower molar area. To determine cytotoxicity, the number of viable cells were compared with control cells. The colorimetric reaction of N -acetyl- β -hexosaminidase, an enzyme involved in the cellular degradation of glycosylated constituents, was used. For the chromogenic substrate solution, 3.75 mM of p -nitrophenol- N -acetyl- β -D-glucosamide (NAG) in 0.05M citrate buffer was used. This solution turns yellowish in an alkaline environment and can be spectrophotometrically measured at 405 nm. After 24, 48, and 72 h of incubation, the cells were washed to remove nonviable cells and 400 μ l of NAG substrate was added. After 3 h of incubation, a buffer solution was added. Absorption was measured on the test solution from the 1st and 2nd weeks. The reaction between the enzyme and the substrate produces a yellow coloration that gives the percentage of viable cells compared to control cells. The percentage of viable cells represented the cytotoxicity level of the tested cements.

RESULTS: PCS showed low cytotoxicity in the 1- and 2-week solutions (100% viable cells to 73.9%). Moderate cytotoxicity was seen in the solutions of Endomethasone and Bioseal. Severe cytotoxicity was seen in test solutions of Rocanal-R2 and AH-26.

C&C: All the cements in the study except AH-26 contain eugenol, which may account for the initial cytotoxicity of PCS, a zinc oxide and eugenol cement. Endomethasone contains hydrocortisone, Rocanal contains a phenolic compound, and AH-26 contains epoxide bisphenol resin which may release formaldehyde during setting, which may account for those materials' toxicity. Although *in vitro* toxicity tests cannot be compared directly to *in vivo* situations, and these results are only relative, they do allow a comparison to be made among different materials, which can be useful in selecting an appropriate sealer.

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Michael Hall

A comparative study of the sealing ability of two root canal obturation techniques

Pallarés A, Faus V. A comparative study of the sealing ability of two root canal obturation techniques. J Endodon 1995;21:449-50.

PURPOSE: To compare the apical sealing capacity of JS Quickfill and lateral gutta-percha (GP) obturation.

M&M: 50 maxillary incisors were randomly divided into two experimental groups of 20 each, and one control group of 10 (5+/5-). Group 1 canals were instrumented by a step-back technique (apical termination file #45), and obturated using GP/AH26. Canals in group 2 were instrumented similarly, and obturated with the JS Quickfill (JSQ)/AH26. [The JSQ appears as a cross between a Thermafil device and a McSpadden compactor, ie a rotary gutta-percha carrier]. A JSQ two sizes smaller than the last file used to prepare the apical third of the canal was positioned, and rotated until GP plasticity was noted. Slight pressure was applied apically until reaching working length. The titanium core of the JQS was then removed while continuing clockwise rotation. All teeth were immersed in India ink for 72 h, cleared, and measured for their linear dye penetration.

RESULTS: Controls behaved as expected. Leakage for the teeth obturated by lateral condensation was 0.48 ± 0.82 mm versus 0.52 ± 0.94 mm in the case of teeth filled with JSQ (no significant difference). Observation of the sealer distribution showed the AH26 situated closest to the dentinal walls whereas the GP was positioned in the center.

C&C: The experimental design may have been adequate in this study, but the article was deficient in facts and weakly written. The JS Quickfill system is still relatively unknown among endodontists, and received only a cursory introduction here. Also, the experimental design was not elaborated on well enough to know whether leakage was measured from the apical foramen, or beginning from the apical extent of the GP. This aspect was deleted from discussion, and the reader is left uncertain where the material terminated apically. Certainly, apical control of gutta-percha and accurate termination of the obturation must be great concerns with use of this device.

September 1995

Christopher F. Bates

The endodontic file as a disposable instrument

Kazemi RB, Stenman E, Spångberg LSW. The endodontic file as a disposable instrument. J Endodon 1995;21:451-5.

PURPOSE: To objectively evaluate the wear of endo files after dentin machining.

M&M: The files tested included K-files (Maillefer and Sjödings), H-files (Maillefer), S-files (Sjödings), Flex-R files (Union Broach), and K-Flex files (Kerr). Size #30 test files with handles removed were clamped in miniature chucks, 3 and 20 mm from the tip, which were part of a freely-moving assembly weighing 100 g. The assembly moved vertically along a track in a push-pull movement along a range of 7 mm. The speed was adjusted to 60 push-pull actions/min. Each test consisted of 300 strokes in dentin, and the recording process consisted of 600 strokes in polymethyl methacrylate. Coronal dentin wafers of 1.5 mm thickness were used, mounted so that the files were always machining in the direction of the dentinal tubules. The experimental procedure consisted of 5 repetitions of 300 strokes in dentin followed by 600 strokes in Plexiglas for each instrument. The machining efficiency was calculated by measuring the surface of the lateral opening of each groove made by the file in the test specimen. Measuring procedures were described in an earlier study (Stenman and Spångberg, 1990).

RESULTS: The Maillefer H-file showed the slowest wear rate of any brand, but the highest relative efficiency after 5 sets of tests was shown by the Maillefer K-file. The other files tested all maintained between 84.4% to 46% of their original machining ability after 300 strokes in dentin. The H- and S-type files were generally less compromised by wear than the K-type files, but after >300 strokes in dentin, most files rapidly lost their dentin-removing effectiveness.

C&C: The tests show that endo files wear rapidly when used on dentin, indicating that they should not be used longer than their effectiveness dictates. Since most dentists or endodontists probably do not know or keep track of how many strokes are used per instrument, the authors feel that endodontic files should be thought of as one-use or one-appointment items, to be disposed of after each use. Personally, I do not think this is necessary for larger size instruments, as long as there is continuous, careful inspection of each instrument as it is being used.

September 1995

Michael Hall

A study of the apical microleakage of a gallium alloy as a retrograde filling material

Hosoya N, Lautenschlager EP, Greener EH. A study of the apical microleakage of a gallium alloy as a retrograde filling material. J Endodon 1995;21:456-8.

PURPOSE: To compare the apical microleakage of gallium alloy, amalgam alloy, a glass ionomer cement, and heat-burnished gutta-percha (GP), when used as root-end filling materials.

M&M: 184 anterior human teeth were decoronized, cleaned and shaped to a size #60, and obturated with GP/Canals sealer (ZOE) using lateral condensation. All were divided into four experimental groups of 40 each, and 12+/12 – controls. Groups 1-3 were apically resected and prepared to a depth of 3 mm and a diameter of 1.5 mm. Group 1 was filled with Gallium Alloy GF, group 2 with Tytin (zinc-free), and group 3 with injectable Glasionomer F/varnish coating. Group 4 GP was heat burnished following apicoectomy. Each group was immediately immersed in 0.6% Rhodamine-B solution for 24 h, 1 wk, 4 wk, and 12 wk. Dye penetration was determined.

RESULTS: Controls behaved as expected. The Glasionomer F showed significantly better sealing ability than the other three groups. The dye penetration in all groups increased with the passage of time. There was no significant difference between the Gallium alloy GF and Tytin. The heat-burnished GP group leaked significantly more than the other experimental groups.

C&C: When examining only sealing ability, gallium alloy appears to be as effective as dental amalgam; however, several material properties (other than sealing ability) determine the in vivo suitability of a root-end filling material. As always, a nice comparison would have included more commonly used products, namely at least one ZOE-based material.

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Christopher F. Bates

Evaluation of a solvent-softened gutta-percha obturation technique in curved canals

Moyer PW, Osetek EM, Ashkenaz P, Gilbert JL. Evaluation of a solvent-softened gutta-percha obturation technique in curved canals. J Endodon 1995;21:459-63.

PURPOSE: To compare the efficacy of 3 obturation techniques in curved canals.

M&M: 24 sets of three morphologically similar, extracted molars were selected. Equal numbers of man and max molars were chosen based on length, size, shape, and root curvature. Only one root per tooth was used. Canals were instrumented using the step-down technique proposed by Goerig et al, 1982. One canal from each group of three was randomly selected for obturation using lateral condensation (LC) of gutta-percha by either a chloroform dip (CD), halothane dip (HD), or a nondipped (ND) technique. For the solvent techniques, GP cones sizes 40 or 45 were fit snugly 1.5-2.0 mm short of WL; for the ND technique, sizes 30 or 35 GP cones were fit snugly 0.5 mm short of the WL. For the CD and HD groups, the apical 5 mm of the respective cones were dipped for 3 s or 15 s, and then immediately placed into the canals to full WL and condensed laterally. 20 sets of three were evaluated following methyl salicylate clearing, with the apical 5-6 mm examined for fill homogeneity, fill extension, and canal anatomy replication, and given grades of A to C. Four sets of triplets were examined under SEM for consistency of canal wall/obturation material interface, replication of internal canal wall anatomy, homogeneity of fill material, and apical extension of filling material into canal preparation.

RESULTS: Statistically significant differences were seen between the CD and HD techniques and the ND technique, but not between the CD and HD techniques. SEM analysis of all specimens showed a generally uniform, narrow canal wall/obturation material interface, with no detectable differences between any of the techniques. Obturation material was present throughout the entire extent of the canal prep for all groups, but replication of canal internal anatomy was better for the CD and HD techniques. The CD and HD fills were also more homogeneous than the ND fills. Pools of sealer could be seen at the apex and between individual cones for the ND group, while sizable voids and generalized surface porosity could be seen at higher magnifications in the CD group. Surface porosity and voids in the HD group were much less evident as compared to the CD group.

C&C: Solvent-softened fills were homogeneous, with filling material seen in fins, lateral canals, and adjacent unprepared canals, in the curved canals prepared in this study. The HD technique produced significantly better obturations than the ND group and exhibited less surface porosity and voids than the CD group. Along with a greater safety margin than chloroform, the halothane-dip technique is thus recommended and endorsed as a good alternative to using chloroform in dip-obturation technique.

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Michael Hall

Comparison of the sealing ability of laser-softened, laterally condensed and low-temperature thermoplasticized gutta-percha

Anic I, Matsumoto K. Comparison of the sealing ability of laser-softened, laterally condensed and low-temperature thermoplasticized gutta-percha. J Endodon 1995;21:464-9.

PURPOSE: To evaluate different laser devices as sources of intracanal heat for producing soft gutta-percha (GP); to test the capability of the argon laser for intracanal photopolymerization of composite resin; and to evaluate and compare the sealing ability of intracanal, laser-softened GP, laterally condensed (LC) GP, Ultrafil system, and composite resin filling.

M&M: 70 single-rooted teeth were endodontically prepared to a minimum apical size of #40 and a maximum of #60, while maintaining patency. Canal smear layer was removed by use of 15% EDTA/5% NaOCl. The teeth were divided into six experimental groups of 10 specimens each, and two control groups of 5 each. Group A canals were obturated with LC-condensed GP/Canals N sealer (ZOE), after chloroform softening; group B used the Ultrafil system - Endoset sealer and SuccessFil; in group C, an argon laser was used to heat GP prior to sectional warm condensation, with sealer; in group D, the GP fragments were softened by the CO₂ laser (0.8 mm metal tip delivery); group E was obturated using the Nd:YAG laser as its heat source; and group F was filled with bonding agent and Clearfil photo posterior composite resin, followed by argon lasing. All roots were suspended in 1% methylene blue dye for 7 d, cleared, longitudinally bisected, and analyzed for extent of dye penetration (from the GP terminus).

RESULTS: Controls behaved as expected. The best sealing ability was found in the group obturated with GP using the LC technique. No statistical difference between LC, Ultrafil, and argon-softened techniques occurred. The most extensive dye leakage was recorded in the canals filled with composite resin. The argon laser produced a more homogenous surface of the GP as compared to the Nd:YAG and CO₂ lasers. Nd:YAG caused burning of GP and sealer, as well as popping sounds. In the middle and coronal thirds, all laser-softened GP demonstrated larger spaces filled with sealer, compared with the non-laser groups.

C&C: Argon lasing showed an acceptable ability to produce softened GP inside the apical canal, when delivered with a flexible fiber. Since only apically positioned GP fragments could be softened by argon lasing, this device (as well as the other lasers) is not yet acceptable for accomplishing complete root canal obturation.

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Christopher F. Bates

Dentinal heat transmission induced by a laser-softened gutta-percha obturation technique

Anic I, Matsumoto K. Dentinal heat transmission induced by a laser-softened gutta-percha obturation technique. J Endodon 1995;21:470-4.

PURPOSE: To measure the temperature changes on the outer root surface during: (a) sectional, laser-softened GP obturation technique; (b) intracanal laser-cured composite resin obturation technique; and (c) use of the Ultrafil low-temperature obturation system.

M&M: Three different lasers were used: Argon laser HGM, the beam delivered through a flexible quartz optical fiber 300 μm in diameter; CO2LX-20D, the beam delivered through a flexible hollow fiber from the apparatus to the handpiece; and Nd:YAG, Dlase-300, with laser power of 2.5 W ($\pm 10\%$) in pulsed mode (25 pps) delivered through a flexible quartz optical fiber 320 μm in diameter. 50 human maxillary anterior teeth were used. Canals were enlarged with a step-back technique to size #40 to #50, and irrigated with 5% NaOCl and 3% H₂O₂. After instrumentation, the smear layer was removed with 15% EDTA and 5% NaOCl for 4 m. Teeth were divided into 5 groups with 10 samples each. Groups A to D were obturated with GP: the master GP cone was sectioned into 2 mm fragments, which were placed into the canal, lased, and condensed with room-temperature hand pluggers. Group A gutta-percha was heated with the argon laser, placed 1 mm from the GP fragment, activated twice with 1 W/2 s, and condensed, followed by successive placement and lasing of GP fragments. Group B gutta-percha was lased with a CO₂ laser beam; Group C with a Nd:YAG laser beam. Group D teeth were obturated using an Ultrafil technique: the apical canal portion was obturated with a K-file introducing low-temperature thermoplasticized SuccessFil GP to the apical stop; the GP was condensed with hand pluggers; additional pre-warmed Endoset green GP was placed in the canal via cannule and syringe and condensed with hand pluggers. Group E canals were obturated with Clearfil Photo Posterior composite resin, with photopolymerization provided in the canal by use of the argon laser. Teeth were mounted into a metal fork and secured with screws in order to obtain root canal obturation and temperature measurements by means of a thermovision camera fitted with 20-degree fields of view standard lens and a Thermal Image Computer TIC-8000 system (AGEMA).

RESULTS: Heat energy was shown by thermovision camera to spread in concentric circles over the external root surface after passing through the dentin. Depending on the laser, temperature elevations of $\sim 10^\circ$ to $\sim 14^\circ$ were recorded, which were considerably less than the 19 to 50° elevations recorded by Fors et al., 1985, following thermo-mechanical obturation. In this study, the laser energy was delivered from outside the canal, directed to the GP and not the dentin walls, and delivered in short and periodic actions, which may prevent cumulative temperature rise. The Nd:YAG laser produced the highest temperature values of the 3 lasers tested. The thermoplasticized technique did not produce detectable temperature changes on the outer root surface.

C&C: A rise in temperature on the external root surface induced by heat transmission from the canal space during different heat-producing obturation techniques can injure the periodontal tissue. Lasers have the potential to transmit heat through the dentin and cause local overheating. According to this study, however, thermomechanical compaction produces more external heat than lasers, which may be useful in heat-requiring GP techniques.

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Michael Hall

Infiltrate of chronic lymphocytic leukemia appearing as a periapical radiolucent lesion

Morgan LA. Infiltrate of chronic lymphocytic leukemia appearing as a periapical radiolucent lesion. J Endodon 1995;21:475-8.

REVIEW: Chronic lymphocytic leukemia (CLL) is a disease of the elderly, is oftentimes asymptomatic, and can cause progressive weakness, fatigue, weight loss, recurrent infections, and cervical lymphadenopathy. A proliferation of a monoclonal line of neoplastic, long-living, and nonfunctional B-cells results in lowered serum immunoglobulin levels and impaired humoral immunity. Leukemic cells infiltrate many tissues including bone marrow, which is diffusely replaced. Radiographic changes are more common in rapidly progressively acute leukemias seen in young patients.

CASE REPORT: A 77-yr-old female presented with a chief complaint of a persistent swelling on her facial gingiva below tooth #28. The mass was slightly indurated and elicited a tingling sensation upon compression. The patient's health history was positive for CLL, diagnosed 3 yr previously. Cold testing gave a normal response on #27, but #28 and 30 were nonresponsive (#29 was missing). Electric pulp testing indicated vital pulps in #27, 28, and 30. Radiographs showed a large radiolucent area extending from the apical area of #27 to the edentulous area distal to #28. A test cavity was performed on #29, which was subsequently pulpectomized; this tooth proved to be pulpally vital. The periapical lesion was biopsied 2 wk later, and the pathologist's findings included abnormal lymphoid proliferation consistent with CLL. At 14 mo post-pulpectomy, the swelling had completely resolved and the extraction socket was healing well, but little change was noted in the radiolucent area.

C&C: In this case, endodontic diagnosis was critical in establishing the need for lesion biopsy. This infiltrative lesion in the jaw appeared to be an indication of increasingly aggressive chronic lymphocytic leukemia. Considering the older population of patients afflicted with CLL and the relatively slow progression of the disease, it is understandable that radiolucent jaw lesions are seldom seen in this disease.

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Christopher F. Bates

Irreversible pulpal damage of teeth adjacent to recently placed osseointegrated implants

Margelos JT, Verdelis KG. Irreversible pulpal damage of teeth adjacent to recently placed osseointegrated implants. J Endodon 1995;21:479-82.

PURPOSE: To present 3 cases of necrosis of previously "vital" teeth next to osseointegrated implant insertion sites.

CASE REPORTS: **Case 1.** A 50-year-old woman was referred for implant placement at the sites of extracted #20, 21, and 22. Ten days following implant insertion, during which perforation of the inferior border of the mandible occurred, she complained of severe pain and was treated for swelling in the area of #23 and 24 with Augmentin. After 5 days she was seen by the authors who pulp-tested #23 and found it pulpally necrotic; xrays revealed the close proximity of the implant to the root of #23. Symptoms resolved after RCT on #23.

Case 2. An implant was placed into the socket of #25 in a 55-year-old man. Eight days later #26 had lingering tenderness to cold and air, with slight percussion tenderness. Sublingual swelling was present, which did not resolve following I&D and antibiotics administered by the oral surgeon. RCT was performed on #26 with an additional round of I&D and antibiotics, after which the abscess resolved. In this case, the mandibular inferior border was also perforated. **Case 3.** Implants were placed in the sites of missing teeth #19 and 21 in a 48-year-old man. Insertion direction at the site of #21 was oblique, toward the apex of #22, in order to miss the mental nerve. The failed implant at site #21 was removed 4 months later due to excessive mobility, at which time #22 tested pulpally nonvital by a prosthodontist who referred the patient for RCT on #22.

C&C: Recent implant placement seems to have resulted in pulpal damage to adjacent teeth in these described cases, probably due to severance of apical blood vessels. Direct surgical injury to the roots seemed unlikely. In addition, the lingual cortical plate was perforated in all 3 cases, which could have resulted in hematoma formation, regional ischemia, or as a substrate for infection in the area, and possibly contributed to the subsequent failure of the implants in the 3 cases. These case reports indicate that, as in osteotomies, severance of apical blood vessels is possible and can lead to severe pulpal damage in adjacent teeth.

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